

# NaI<sup>TM</sup> Scintillation Crystal

## Neutron Detection Efficiency Testing

The Neutron Detection efficiency for NaI<sup>TM</sup> crystals is tested at Saint-Gobain Crystals with the crystal placed in a High Density Polyethylene (HDPE) and a Cf-252 source.

The test fixture is constructed of 2" thick High Density Polyethylene (HDPE) for the base, side, and back walls. The interior space between the walls is approximately 6". The Cf-252 source capsule is surrounded by 5mm thick lead and 25mm thick HDPE. The source to detector spacing is 300mm measured from the surface of the detector housing to the center point of the source. The test configuration is shown in figure 1.

The anode output from the detector is connected to a CAEN 5730 digitizer programmed with Pulse Shape Discrimination (PSD) firmware and controlled by a computer running CAEN's Compass software. The software is capable of generating Pulse Height (PH) and PSD spectra. Sample spectra are shown in figure 2.

The PSD parameter is "Tail to Total Ratio", that is the amount of charge from the PMT in the Tail of the pulse as a fraction of the Total charge. Two integration windows are established. The first window (W1) is 0 to 600ns. The second window (W2) is from 0 to 1500ns. Thus  $Total=W2$  and  $Tail=W2-W1$ , and the Tail to Total PSD is,  $PSD=(W2-W1)/W2$ .



Figure 1. Photograph of a NaI detector in the test fixture with the neutron source in the foreground.

To obtain the neutron efficiency, we set acceptance windows on both the energy and the PSD parameter. The number of events satisfying both conditions is displayed as “output counts” on the PH spectrum. Dividing this number by the “Live Time” gives neutron counts per second, and dividing that result by the calculated source mass gives the neutron efficiency in counts per second per nanogram.

Figure 2.  
Sample Pulse Height spectrum spectra from a NaI(L) detector 2"x4"x8" acquired with the Compass software.

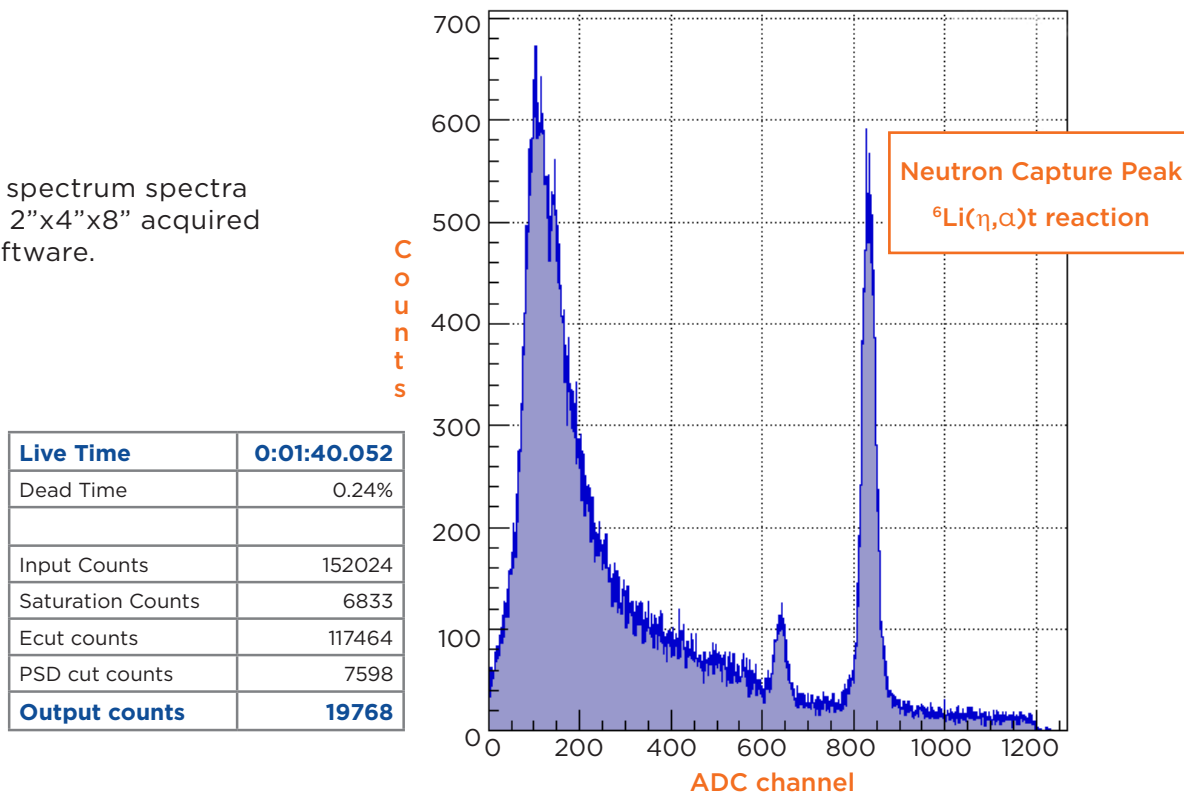
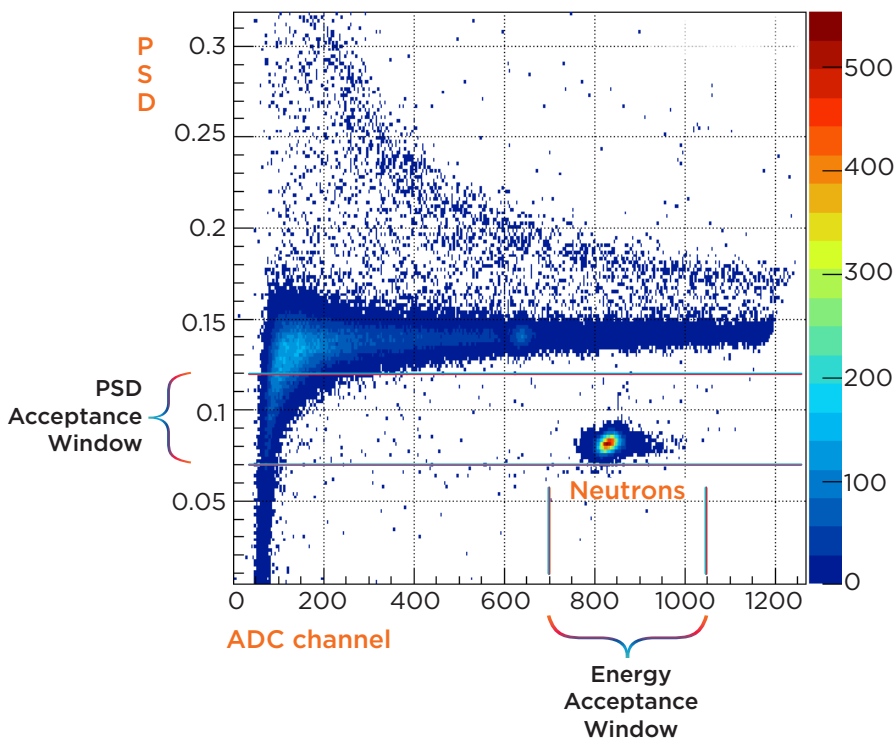


Figure 3.  
A 2 parameter PSD spectrum from a NaI(L) detector 2"x4"x8" acquired with the Compass software.



Data Compiled and Edited by Mike Kusner

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